Mathematics

Year 7
Above satisfactory

WORK SAMPLE PORTFOLIO

Annotated work sample portfolios are provided to support implementation of the Foundation – Year 10 Australian Curriculum.

Each portfolio is an example of evidence of student learning in relation to the achievement standard. Three portfolios are available for each achievement standard, illustrating satisfactory, above satisfactory and below satisfactory student achievement. The set of portfolios assists teachers to make on-balance judgements about the quality of their students' achievement.

Each portfolio comprises a collection of students' work drawn from a range of assessment tasks. There is no pre-determined number of student work samples in a portfolio, nor are they sequenced in any particular order. Each work sample in the portfolio may vary in terms of how much student time was involved in undertaking the task or the degree of support provided by the teacher. The portfolios comprise authentic samples of student work and may contain errors such as spelling mistakes and other inaccuracies. Opinions expressed in student work are those of the student.

The portfolios have been selected, annotated and reviewed by classroom teachers and other curriculum experts. The portfolios will be reviewed over time.

ACARA acknowledges the contribution of Australian teachers in the development of these work sample portfolios.

THIS PORTFOLIO: YEAR 7 MATHEMATICS

This portfolio provides the following student work samples:

Sample 1	Number and algebra: Algebra and the Cartesian plane
Sample 2	Number: Integers
Sample 3	Number: Indices
Sample 4	Geometry: Geometry Review
Sample 5	Geometry: Emily's castle
Sample 6	Measurement: Measurement investigation

This portfolio of student work represents numbers using variables, connects the laws and properties for numbers to algebra and evaluates algebraic expressions after numerical substitution (WS1). They represent authentic information using linear models, and represent and plot points on the Cartesian plane (WS1). They use formulas for the area of rectangles and the volume of rectangular prisms (WS6). The student solves problems involving the comparison, addition and subtraction of integers (WS2). They interpret different views of three-dimensional objects (WS5). They use index notation to represent the prime factorisation of whole numbers and recognise the relationship between perfect squares and square roots (WS3). They classify triangles and describe quadrilaterals, solve simple numerical problems in geometry, including those involving angles formed by transversals crossing pairs of parallel lines (WS4).

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Number and algebra: Algebra and the Cartesian plane

Year 7 Mathematics achievement standard

The parts of the achievement standard targeted in the assessment task are highlighted.

By the end of Year 7, students solve problems involving the comparison, addition and subtraction of integers. They make the connections between whole numbers and index notation and the relationship between perfect squares and square roots. They solve problems involving percentages and all four operations with fractions and decimals. They compare the cost of items to make financial decisions. Students represent numbers using variables. They connect the laws and properties for numbers to algebra. They interpret simple linear representations and model authentic information. Students describe different views of three-dimensional objects. They represent transformations in the Cartesian plane. They solve simple numerical problems involving angles formed by a transversal crossing two parallel lines. Students identify issues involving the collection of continuous data. They describe the relationship between the median and mean in data displays.

Students use fractions, decimals and percentages, and their equivalences. They express one quantity as a fraction or percentage of another. Students solve simple linear equations and evaluate algebraic expressions after numerical substitution. They assign ordered pairs to given points on the Cartesian plane. Students use formulas for the area and perimeter of rectangles and calculate volumes of rectangular prisms. Students classify triangles and quadrilaterals. They name the types of angles formed by a transversal crossing parallel line. Students determine the sample space for simple experiments with equally likely outcomes and assign probabilities to those outcomes. They calculate mean, mode, median and range for data sets. They construct stem-and-leaf plots and dot-plots.

Summary of task

Students had completed units of work on algebra and the Cartesian plane. The task consisted of a series of written questions on the topic and students were asked to complete the task under test conditions in a lesson.

Number and algebra: Algebra and the Cartesian plane

Algebra and the Cartesian Plane

Part A: Algebra

1. Write using symbols:

a. The total of x and y

$X + y$

b. The multiple of 6 and p

$6 \times p = 6p$

c. t decreased by 2

$t - 2$

d. The product of y and 5, less x.

$y \times 5 - x$
$= 5y - x$

2. If c= 2 and b= 5, evaluate:

a. b – c

$5 - 2 = 3$

b. 6bc

$6 \times b \times c$
$= 6 \times 5 \times 2$
$= 60$

c. (b + c) ÷ 7

$(5+2) \div 7$
$= 7 \div 7$
$= 1$

3. In the expression 3x + 5, which is the

a. variable?

X

b. operation?

$+$

c. factor with the pronumeral?

is this the same as the coefficient? I guess so

4. Simplify the following expressions.

a. 2x + 3x

$= 5x$

b. 2a + b + 4a

$= 6a + b$

c. 5x – 3x + x

$= 3x$

d. 2 x 4y

$= 8y$

e. 4a ÷ 2

$= 2a$

f. 2x + x² + 3x

$= 5x + x^2$

Annotations

Demonstrates understanding of mathematical terminology when writing algebraic representations of statements in words.

Substitutes given values for variables to evaluate simple algebraic expressions correctly.

Distinguishes between variables, their coefficients and operations.

Simplifies algebraic expressions, including collecting like terms.

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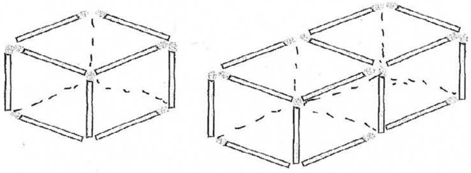
Number and algebra: Algebra and the Cartesian plane

5. Look at the diagram below to answer:



a.

Draw up a table showing number of shapes and number of matches used. I didn't know whether this meant all matches or just the showing ones

matches showing

Shapes	s	1	2	3	4	5	6	7	8	9
Number of matches	m	9	14	19	24	29	34	39	44	49

All matches

Shapes	s	1	2	3	4	5	6	
Number of matches	m	12	20	28	36	44	52.	

b.

Select pronumerals to stand for the two variables and express the rule in algebraic form. shapes – s number of matches – m

matches showing $m = 5 \times s + 4$
$m = 5s + 4$

all matches $m = 8 \times s + 4$
$= 8s + 4$

c.

Calculate from the rule the number of matches needed to form 15 shapes.

matches showing $m = 5 \times 15 + 4$
$= 75 + 4$
$= 79$

all matches $m = 8 \times 15 + 4$
$= 124$

d.

Find by substitution in the rule how many shapes can be formed from 49 matches. see tables in 5a

matches showing
9 shapes can be made from 49 matches.

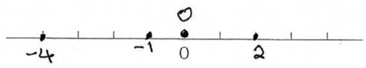
all matches. you can't make an exact number of whole shapes from 49 matches, so question must mean showing matches only

Total

PART B: The Cartesian Plane

1. Graph the set of numbers onto the number line given

{2, -1, -4, 0}



2. Penny checks her bank account balance and it reads $ - 240.00 .
   a. What does this mean for Penny? She has overdrawn her account by $ 240
   b. If she deposits $40, what is her new balance? $ -200 . 00

Annotations

Constructs a table of values to record two possible number patterns and demonstrates mathematical insight by questioning the intent of the question.

Defines variables and writes rules to represent the patterns in their tables of values.

Substitutes into their rule to obtain the number of matches required for a given number of shapes.

Uses their rules to obtain the number of shapes for a given number of matches and reflects on the intent of the question.

Locates and plots integers on a number line.

Describes integers in context and solves a simple problem involving integers.

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Number and algebra: Algebra and the Cartesian plane

7.

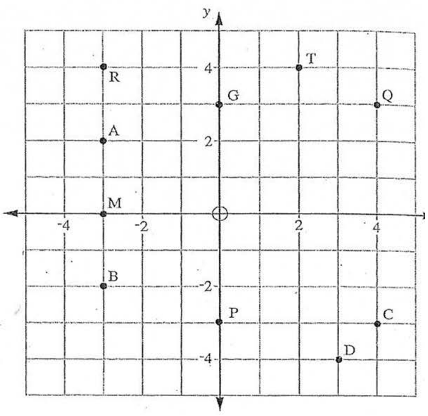
a. T (2,4)

b. A (-3, 2)

c. C (4,-3)

d. P (0,-3)

e. M (-3, 0)

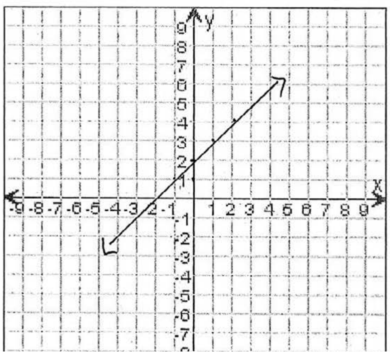


a. Complete the table of values using the rule given

$y = x + 2$

x	-1	0	1	2
y	1	2	3	4

b. Plot these coordinates on the grid below to graph the straight line



Annotations

States the coordinates of points on the Cartesian plane using the correct notation.

Uses an algebraic rule to complete a table of values.

Plots points on the Cartesian plane and draws a straight line to connect the points.

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Number: Integers

Year 7 Mathematics achievement standard

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Students use fractions, decimals and percentages, and their equivalences. They express one quantity as a fraction or percentage of another. Students solve simple linear equations and evaluate algebraic expressions after numerical substitution. They assign ordered pairs to given points on the Cartesian plane. Students use formulas for the area and perimeter of rectangles and calculate volumes of rectangular prisms. Students classify triangles and quadrilaterals. They name the types of angles formed by a transversal crossing parallel line. Students determine the sample space for simple experiments with equally likely outcomes and assign probabilities to those outcomes. They calculate mean, mode, median and range for data sets. They construct stem-and-leaf plots and dot-plots.

Summary of task

Students were asked to complete a quiz in class after completing a revision of integers and their application in authentic situations.

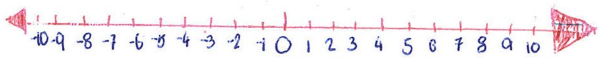
Number: Integers

Integers

Integers are all of the positive and negative whole numbers including zero.

A number line is very useful when working with integers.

1. Draw a number line from -10 to +10



As you move right along the number line, the numbers ascend or get larger.

2. Arrange the following integers in ascending order:

a. 8, -3, 6, 0, 2, -4, -7

-7, -4, -3, 0, 2, 6, 8

b. 34, 23, -6, 4, -65, 3, -63

-66, -63, -6, 3, 4, 23, 34

3. Samantha was keeping score for a card game she and her friends were playing. The scores are listed below. Rank each player according to their score from lowest score to highest score.

Jack -100, Josh 200, Casey -500, Claire –50, Chris 1500, Blake 1600 and Lara -10

-500, -100, -50, -10, 200, 1500, 1600

4. Write '>' or '<' to make the following statements correct.

a. -32 _>_ -35

b. 0 _>_ -4

c. -7 _>_ -10

d. 12 _>_ -29

Adding and Subtracting Integers

ADDITION

-2 + (-3) = **-5**

2 negatives plus 3 negatives equals 5 negatives.

| - | - | | + | | - | - | - | | = | | - | - | - | - | - |

5. The above example shows you the result of -2 + (-3). What addition rule do you learn from the above example? when there is a + & a - in the middle of two numbers, then the minus over-rules, resulting in a negative number.

Annotations

Creates a number line showing positive and negative integers that are evenly spaced.

Orders integers from smallest to largest..

Compares integers using mathematical symbols.

Demonstrates understanding of the effect of adding two negative integers.

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Number: Integers

6. Calculate the following using a number line.

a. -7 + 5 = -2 b. 4 + (-8) = -4

c. -24 + 34 = 10 d. -8 + 8 = 0

e. 11 + (-6) = 5 f. -7 + (-10) = -17

g. 5 + (-5) = 0 h. -6 + 7 + (- 4) = -3

SUBTRACTION

When you subtract integers, think of the problem as 'take – away'.

-4 – (-2) = **-2**

4 negatives take away 2 negatives equals 2 negatives.

-	-	-	-	- (take – away)	-	-	=	-	-

7. The above example shows you the result of -4 – (-2). What subtraction rule do you learn from the above example? When there are two minus' in the center, then it becomes a + [illegible]

8. Calculate the following using a number line.

a. 6 – (-5) = 11 b. 18 – (-10) = 28

c. -3 – (-3) = 0 d. -2 – (-13) = 11

e. 6 – (-3) – 7 = 2 f. 13 – 20 – (-5) = -2

9. Complete the magic square.

-4	0	1
4	-1	-6
-3	-2	2

10. The temperature in Canberra at midday was 12°C. By midnight it had dropped to -5°C. By how much did the temperature drop?

Annotations

Correctly adds integers.

Describes the effect of subtracting a negative integer.

Correctly subtracts integers.

Solves problems using addition of integers.

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Number: Integers

11. What is the combined effect of a gain in weight of 5 kg and then a loss of 12 kg?

-7kg

12. What will be the net result if Tara deposits $400 in her account followed by a withdrawal of $700?

-$300

Integers and Golf

In golf, **par** is the pre-determined number of strokes that a golfer requires to complete a hole. Your score is 0 if you get the ball in the hole using par number of strokes. If your number of shots for the hole is less than par then your score is negative. If your number of shots for the hole is greater than par then your score is positive. Play 5 holes golf with your friend and complete the table below to determine who won.

Instructions:

Throw a set of three dice until you roll a double. **The double represents the hole** and each throw is counted as a stroke you take to get the ball in that hole.
Example: Strike one : 2, 5, 3. Strike two : 3, 1, 6. Strike three : 4, 5, 4. It has taken this player a total of 3 strokes to get the ball in the hole. Record this in the shots column and then allow your opponent to do the same. Repeat the above procedure for the rest of the holes. After the 5th hole, get the total of the **par score** column to find out who won.

13.

		Name:		Name:	
HOLE	**PAR**	**SHOTS**	**PAR SCORE**	**SHOTS**	**PAR SCORE**
1	3	4	+1	1	-2
2	4	5	+1	1	-3
3	3	1	-2	3	0
4	5	2	-3	5	0
5	2	3	+1	3	+1
TOTAL	**17**	15	-2	13	-4

What is the difference between the TOTAL of PAR and your Total number of SHOTS?

Check if this answer is the same as the total of PAR SCORE.

The difference between the Total of Par and my total number of shots is -2. My total number of shots is not the same as my par score, infact there is a difference of +17.

Annotations

Solves problems involving subtraction of integers in context.

Uses negative symbol to represent the decrease of value.

Calculates the addition of multiple integers.

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Number: Indices

Year 7 Mathematics achievement standard

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>
> *Students use fractions, decimals and percentages, and their equivalences. They express one quantity as a fraction or percentage of another. Students solve simple linear equations and evaluate algebraic expressions after numerical substitution. They assign ordered pairs to given points on the Cartesian plane. Students use formulas for the area and perimeter of rectangles and calculate volumes of rectangular prisms. Students classify triangles and quadrilaterals. They name the types of angles formed by a transversal crossing parallel line. Students determine the sample space for simple experiments with equally likely outcomes and assign probabilities to those outcomes. They calculate mean, mode, median and range for data sets. They construct stem-and-leaf plots and dot-plots.*

Summary of task

Students had completed a unit of work on indices with whole numbers, including writing whole numbers as a product of their prime factors, the connection between perfect squares and square roots, and the calculation of square roots of whole numbers.

Students were asked a series of questions that involved identifying factors of numbers, calculating perfect squares and their squares roots, and finding the greatest common divisor (highest common factor) using whole numbers written as a product of their prime factors. The use of calculators was not permitted and students were given 25 minutes of class time to complete the task.

Mathematics

Year 7
Above satisfactory

Number: Indices

Indices Calculators are NOT permitted

1) Which dot pattern represents the first four square numbers? Circle the correct answer.

2) In the expression 5^{20}, what is the mathematical term used to describe the numeral 5? Circle the correct answer.

(A) base (B) bottom (C) index (D) power

3) Write down any two square numbers that are larger than 60: 64 and 81

4) Write down all the factors of each number.

a) 48 1,2,3,4,6,8,12,24,48

b) 66 1,2,3,6,11,22,33,66

5) What is the highest common factor of 48 and 66? 6

6) Write down 7^8 in expanded form (ie without index notation). You do not need to evaluate the expression.

7x7x7x7x7x7x7x7

7) To work out the value of 18^2, Anh drew a diagram. Part of his diagram is shown below.

	10	+ 8
10	100	80
+ 8	80	64

a) Place the correct value in each part of the diagram.

b) Write down a numerical expression that shows how the diagram can be used to evaluate 18^2 and use this to find the value of 18^2.

100+80+80+64 =324

Annotations

Identifies a visual representation of square numbers.

States two square numbers.

Identifies factors of numbers and writes them in ascending order but omits the factor 16 of the number 48.

Identifies the greatest common divisor (highest common factor) of two given two-digit numbers from lists of their factors.

Demonstrates understanding of index notation.

Uses an area diagram to show how the square of a two-digit number can be calculated.

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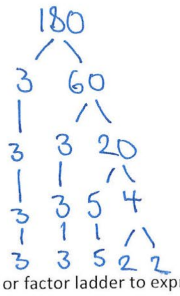
Number: Indices

8) Consider the numbers 180 and 600.

a) Draw a factor tree or factor ladder for the number 180.



b) Use your factor tree or factor ladder to express 180 as a product of its prime factors.

$\therefore 180 = 3 \times 3 \times 5 \times 2 \times 2$
$= 3^2 \times 5 \times 2^2$

c) Given that $600 = 2^2 \times 3 \times 5^2$, find the highest common factor of 180 and 600.

$2 \times 2 \times 3 \times 5$
$10 \times 2 \times 3$
20×3

60

9) Given that $529 = 23^2$, what is the value of $\sqrt{529}$? 23

10) Given that $1764 = 2^2 \times 3^2 \times 7^2$, what is the value of $\sqrt{1764}$? 42

11) Given that $18\ 662\ 400 = 2^{10} \times 3^6 \times 5^2$, find $\sqrt{18\ 662\ 400}$. Leave your answer as a product of primes in simplest index form.

$18\ 662\ 400 =$
$2 \times 2 \times 2 \times 2 \times 2 \times \cancel{2} \times \cancel{2} \times \cancel{2} \times \cancel{2} \times \cancel{2} \times 3 \times 3 \times 3 \times \cancel{3} \times \cancel{3} \times \cancel{3} \times 5 \times \cancel{5}$
$= 2 \times 2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 3 \times 5 = 2^5 \times 3^3 \times 5$

12) Jenny wrote:

'All numbers have an even number of factors because factors always come in pairs.'

Is Jenny correct? Give a reason for your answer, and provide at least one example to support your decision.

No Jenny is not correct because when a number is a square number the factor is ~~tim~~ multiplied by it self eg $36 = 6 \times 6$ $\therefore$ 6 does not have a pair.

Annotations

Constructs a factor tree for a three-digit number.

Uses a factor tree to write the given number as a product of primes using index notation.

Demonstrates understanding of how to use the prime factors of a pair of three-digit whole numbers to find their greatest common divisor (highest common factor).

Finds the square roots of whole numbers given their equivalent as a perfect square or as a product of perfect squares.

Demonstrates understanding of index notation and uses this to calculate the square root of a whole number given its prime factors.

Comments on the validity of a statement using appropriate mathematical language and justifies their response citing a generalisation about the properties of square numbers and providing an example.

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Geometry: Geometry review

Year 7 Mathematics achievement standard

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Summary of task

Students had completed a unit of work on geometric reasoning.

Students were asked a series of questions that involved applying:

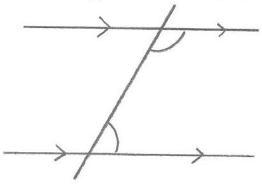
- the angle and side properties to classify triangles and describe quadrilaterals
- the properties of angles on a straight line, angles at a point and vertically opposite angles to solve numerical problems with appropriate reasoning
- the angle relationships formed when parallel lines are crossed by a transversal to solve numerical problems with appropriate reasoning
- the angle sum of a triangle to solve numerical problems with appropriate reasoning.

The use of calculators was permitted and students were given 40 minutes of class time to complete the task.

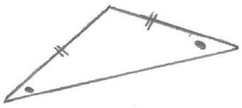
Geometry: Geometry review

Geometry Review

1) Draw and label a pair of **parallel lines** and a **transversal** and clearly indicate the location of **ONE pair of co-interior angles**. Your diagram does not have to be drawn to scale.



2) Make a neat sketch of an **obtuse-angled isosceles triangle**, labelling any equal sides or angles with appropriate symbols.



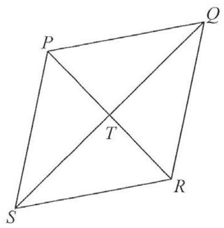
3) Name the **quadrilateral** that has opposite sides are parallel **AND** diagonals that are equal in length.

Name of quadrilateral: ....Square....................................

4) Can a triangle have **more than one** right angle? Give a reason for your answer.

no, the sum of the angles must add to 180°. ~~th~~ two 90° angles would already create that sum, leaving no room for a third angle.

5) Which **one** of these statements about rhombus $PQRS$ is **not true**?



(A) $QS \perp PR$

(B) $PT = TQ$

(C) $PQ = QR$

(D) $\angle PQS = \angle RQS$

(E) $\angle PST = \angle TQR$

(F) $PQ \parallel SR$

Annotations

Draws and labels parallel lines using appropriate geometrical notation and indicates the position of a pair of co-interior angles formed by a transversal.

Draws and labels an obtuse-angled triangle. Uses appropriate geometrical conventions to indicate the equal sides and equal angles of an isosceles triangle.

States a quadrilateral with the given properties but does not provide the more inclusive classification of 'rectangle'.

Provides an answer with clear reasoning that connects the number of angles in a triangle with the angle sum of a triangle.

Recognises properties of a rhombus.

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Geometry: Geometry review

6) Circle **true or false** for each statement.

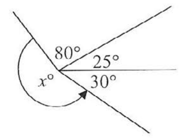
a) All rectangles are squares. true **false**

b) Some rhombuses are parallelograms. true **false**

c) All squares are rhombuses. **true** false

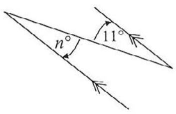
7) Find the **value** of each pronumeral, giving a **reason** for each. [Diagrams are not drawn to scale.]

a)



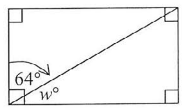
$x =$ 225° [360 − (80+25+30) = 225
135]

b)



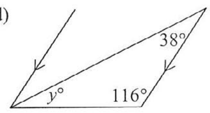
$n =$ 11° [Alternate angles on parallel lines are equal]

c)



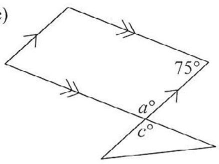
$w =$ 26° [A right angle is 90°
90 − 64 = w
26 = w]

d)



$y =$ 26° [Angle sum of a triangle is 180°]
180 − (116+38)

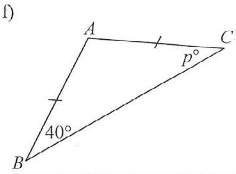
e)



$a =$ 105° [Co-interior angles add to 180°]

$c =$ 105° [Vertically opposite angles are equal]

f)



$p =$ 40° [Isosceles triangles have equal angles
at the base.]

Annotations

Recognises that particular quadrilaterals can be classified in more than one way.

Calculates correct values in simple numerical problems in geometry.

States appropriate angle relationships, including noting the significance of lines being parallel in the formation of equal alternate angles and supplementary co-interior angles when providing reasons for numerical calculations in geometry.

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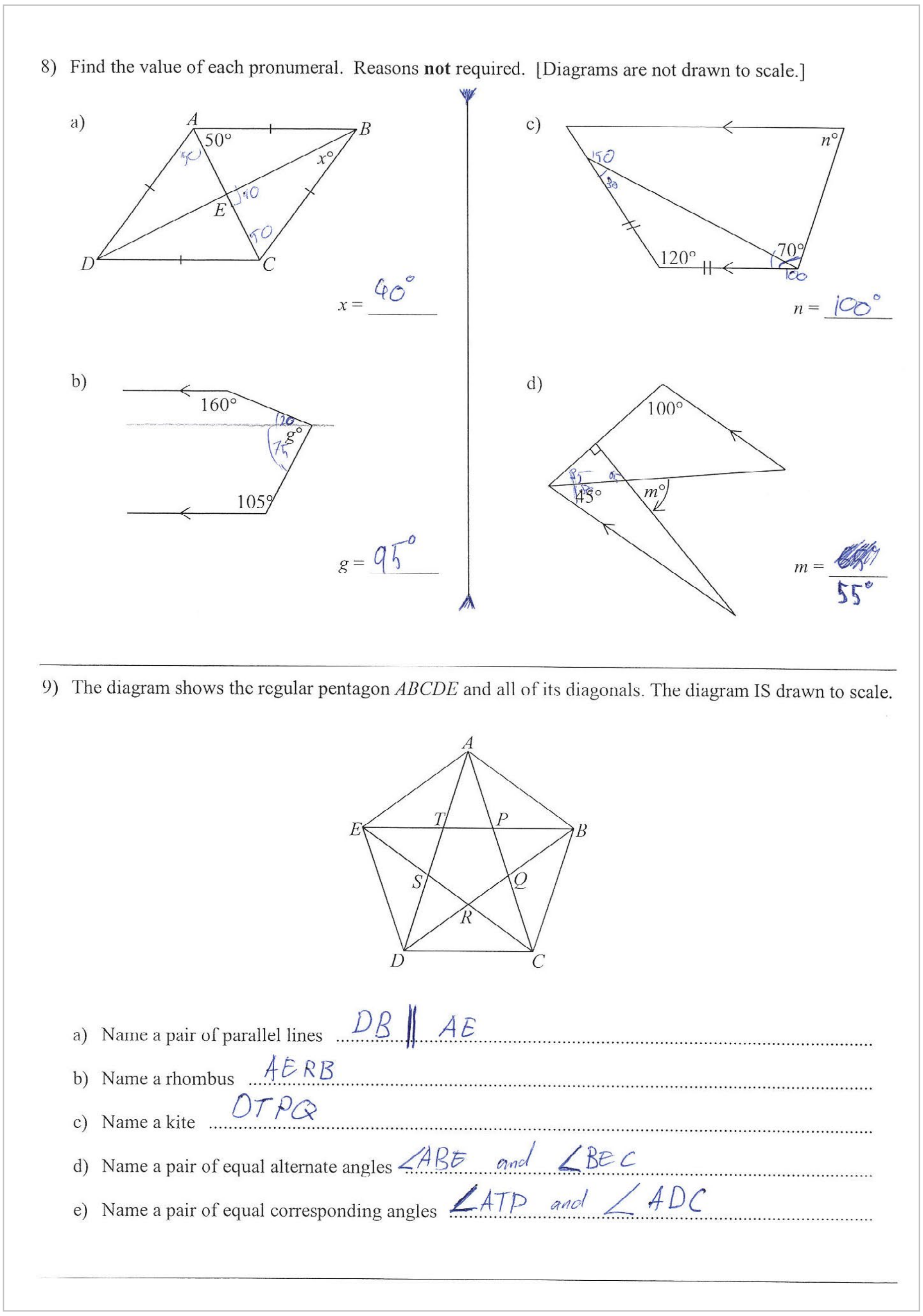
Mathematics

Year 7

Above satisfactory

Geometry: Geometry review



8) Find the value of each pronumeral. Reasons **not** required. [Diagrams are not drawn to scale.]

a) $x =$ 40°

b) $g =$ 95°

c) $n =$ 100°

d) $m =$ ~~60°~~ 55°

9) The diagram shows the regular pentagon *ABCDE* and all of its diagonals. The diagram IS drawn to scale.

a) Name a pair of parallel lines DB ∥ AE

b) Name a rhombus AERB

c) Name a kite DTPQ

d) Name a pair of equal alternate angles ∠ABE and ∠BEC

e) Name a pair of equal corresponding angles ∠ATP and ∠ADC

Annotations

Uses angle relationships to solve multi-step numerical problems in geometry but with one minor error.

Identifies and names a pair of parallel lines using appropriate geometrical notation.

Identifies and names quadrilaterals using appropriate geometrical notation.

Identifies and names equal pairs of corresponding angles and alternate angles when parallel lines are crossed by a transversal, using appropriate geometrical notation.

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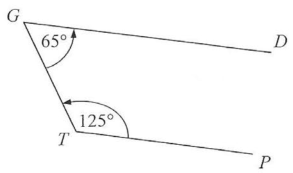
Geometry: Geometry review

10) The diagram below is not drawn to scale.



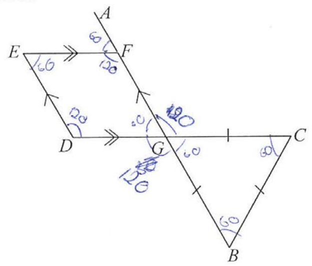
Are the lines DG and PT parallel? Give a reason why or why not.

no co-interior angles on parallel lines add to 180°.

65+125=190

∴ lines GD and PT are NOT parallel

11) In the diagram below, AB and DC are straight lines intersecting at the point G. EF is parallel to DC.
The diagram is not drawn to scale.



Jamie was asked to find the size of $\angle EFA$ and wrote the following in his workbook.

Complete the gaps in his work.

$\angle CGB = 60°$ [angle sum of a triangle is 180°, equalateral triangles have equal angles 180÷3=60]

$\angle FGD = 60°$ [Vertically opposite angles are equal ....]

$\angle EFA =$ 60 [Angles on a straight line add to 180 ....]

Annotations

Determines whether or not a pair of straight lines are parallel and uses an appropriate angle relationship to justify the answer.

Applies a sequence of angle properties to obtain an answer to a multi-step numerical problem in geometry. Provides a geometrical reason for each step but without the most efficient reasoning for the last step.

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Geometry: Emily's castle

Year 7 Mathematics achievement standard

The parts of the achievement standard targeted in the assessment task are highlighted.

By the end of Year 7, students solve problems involving the comparison, addition and subtraction of integers. They make the connections between whole numbers and index notation and the relationship between perfect squares and square roots. They solve problems involving percentages and all four operations with fractions and decimals. They compare the cost of items to make financial decisions. Students represent numbers using variables. They connect the laws and properties for numbers to algebra. They interpret simple linear representations and model authentic information. Students describe different views of three-dimensional objects. They represent transformations in the Cartesian plane. They solve simple numerical problems involving angles formed by a transversal crossing two parallel lines. Students identify issues involving the collection of continuous data. They describe the relationship between the median and mean in data displays.

Students use fractions, decimals and percentages, and their equivalences. They express one quantity as a fraction or percentage of another. Students solve simple linear equations and evaluate algebraic expressions after numerical substitution. They assign ordered pairs to given points on the Cartesian plane. Students use formulas for the area and perimeter of rectangles and calculate volumes of rectangular prisms. Students classify triangles and quadrilaterals. They name the types of angles formed by a transversal crossing parallel line. Students determine the sample space for simple experiments with equally likely outcomes and assign probabilities to those outcomes. They calculate mean, mode, median and range for data sets. They construct stem-and-leaf plots and dot-plots.

Summary of task

Students had completed a unit on geometry that including drawing and interpreting different views of three-dimensional objects. Students learned how to use a virtual drawing tool to construct three-dimensional objects and represent these objects in two dimensions.

In the task, students were asked to:

- draw front, right side and top views of three-dimensional objects constructed from centicubes on square grid paper and also on isometric grid paper
- use a virtual drawing tool to construct a variety of three-dimensional objects (and represent this object in two-dimensions) given a particular set of front, top and side views and certain conditions.

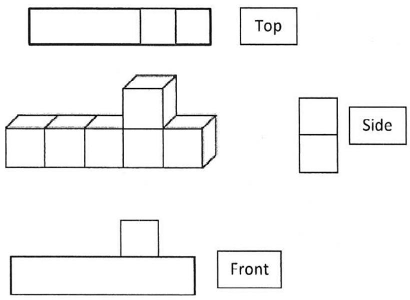
Students were given two lessons with access to the virtual drawing tool to complete the task.

Geometry: Emily's castle

Part A: Knowledge and Understanding

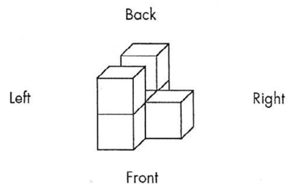
Question One: Front / Side / Top Views of 3 Dimensional Objects

In architecture and many other fields 2 dimensional drawings are used to represent 3 dimensional objects. In this question you are required to draw 2 dimensional drawings which represent what can be seen if you are looking at a 3 dimensional object from either the front, one of the sides, the back or from above the object. An example is shown below.

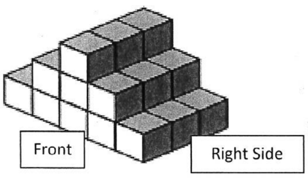


On the square paper provided draw the front, right side and top views of the solids shown.

(a)



(b)



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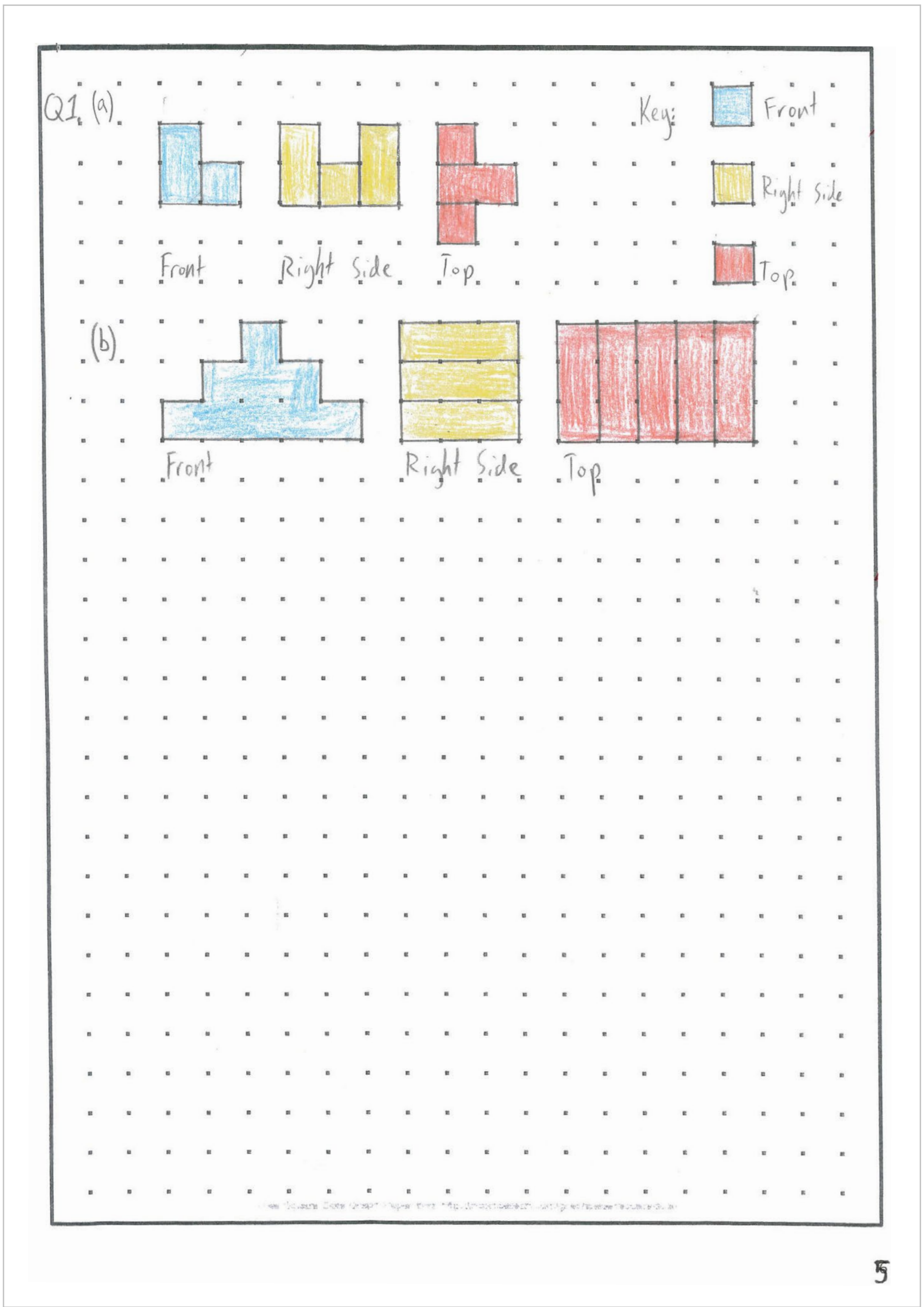
Mathematics

Year 7
Above satisfactory

Geometry: Emily's castle



Annotations

Draws different views of a three-dimensional object, correctly indicating changes in height in all diagrams.

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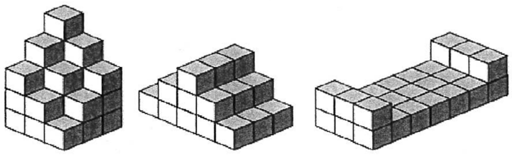
Geometry: Emily's castle

Question Two: **Isometric Drawings**

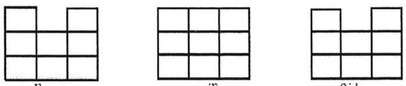
Isometric drawing is a method of representing 3 dimensional objects using 2 dimensions. Use the isometric drawing paper attached to reproduce the drawings below. Use colours to indicate the faces which would appear in the top view, front, right side and left side views. Include a legend with your diagrams.



crystal stairs bed

Part B: Problem Solving and Reasoning

Emily has designed plans for a castle that show the front, top, and side views. Unfortunately she has not used the system of identifying different heights using lines, so you are unable to discern whether or not blocks are on the same or different levels from her digarams.



Front Top Side

Question Three:

What is the largest number of cubes that you can use in the construction of a castle from Emily's plans?

- Clearly explain how you obtained your answer.
- Use the virtual isometric drawing tool provided to draw the castle with the maximum amount of blocks.
- Use the 2-D feature of the drawing tool to show that the top, front and side perspectives are correct.

Question Four:

What is the smallest number of cubes that you can use in the construction of a castle from Emily's plans?

- Clearly explain how you obtained your answer.
- Use the virtual isometric drawing tool provided to draw the castle with the minimum number of cubes.
- Use the 2-D feature of the drawing tool to show that the top, front and side perspectives are correct.

Question Five:

How many symmetrical castles can you build to that satisfy Emily's specifications? [Your solution must be accompanied by an explanation]

- Use the virtual isometric drawing tool provided to draw the castles which match Emily's design and are symmetrical
- Use the 2-D feature of the drawing tool to show that the top, front and side perspectives are correct.

Annotations

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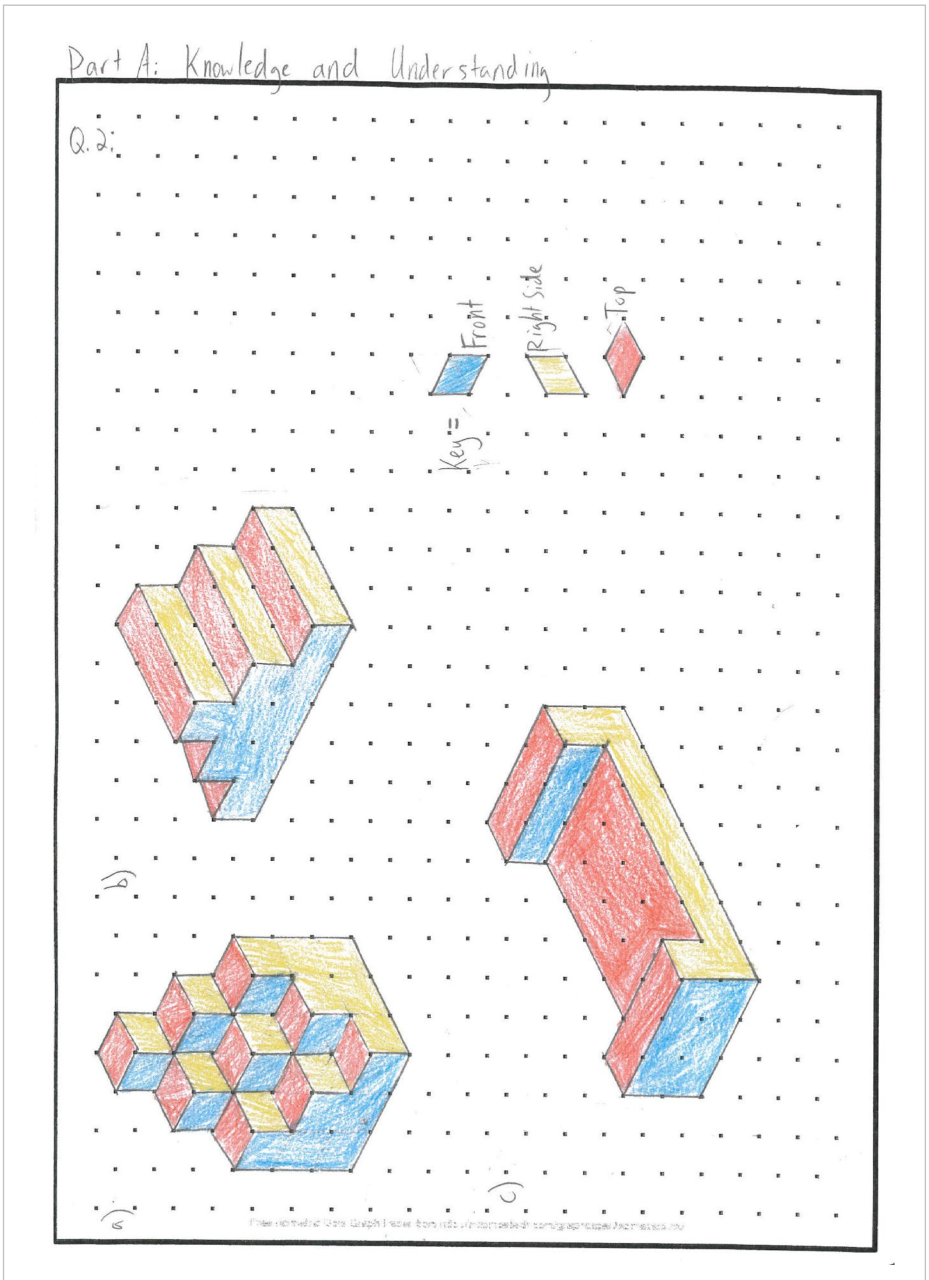
Geometry: Emily's castle



Annotations

Draws three-dimensional objects on isometric paper, correctly indicating faces.

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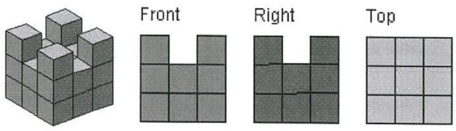
Geometry: Emily's castle

Part B: Problem Solving and Reasoning

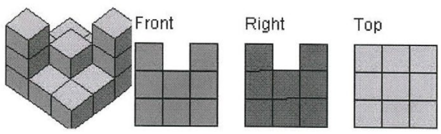
Q 3:

- Answer: 22 Cubes
- This is the highest number of cubes that could be used as it was as long, wide and tall as the design plans allowed. No cubes were removed from the possible base (9 cubes), middle (9 cubes), top (4 cubes) or unseen sides of the cube, forming (from the 3D top perspective) vertical, horizontal and diagonal symmetry and (from both 3D front and right/side views) vertical symmetry.



Q 4:

- Answer: 14 cubes
- This is the lowest number of cubes as no cubes could be removed from the base (9 cubes) while only 2 cubes were used to form the top (4 cubes total) and 1 cube was added to form the centre cube portrayed in all front, right and top plans. This castle was only symmetrical diagonally from the 3D top perspective and horizontally from the corner of the 3D front and side views. No other cubes could have been taken away as these cubes cannot be supported by edges, only faces.



Annotations

Determines the maximum number of cubes that can be used to construct a three-dimensional object with the required front, top and side views.

Explains how to determine the maximum number of cubes that can be used.

Uses the virtual drawing tool to draw the three-dimensional object and its different views.

Determines the minimum number of cubes that can be used to construct a three-dimensional object with the required front, top and side views.

Explains how to determine the minimum number of cubes that can be used.

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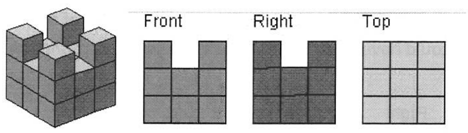
Geometry: Emily's castle

Q 5:

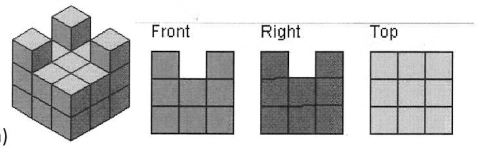
Answer: At least 35 original shaped symmetrical castles.
This answer included only the perspectives of a select view, and many of the below solutions can be multiplied by 4 due to rotational congruency to add to the overall answer of symmetrical castles. Shapes could only be rotated by multiples of 90 degrees (with the exclusion of 360 degrees and over) in order to create a different castle from the original perspective though some castles were congruent when rotated by smaller degrees. Solution 22 (cubes)a or 21b, could not be multiplied as the shape was symmetrical diagonally, vertically and horizontally from the 3D top perspective including depth. However, solution 21a could be multiplied by 4 as the removed block from the top row could be rotated around to any of the other top row cube positions. Solution 20a could be multiplied by 2 as 2 of the top 4 blocks were removed and the shape could be rotated 180 degrees in order to create a different castle.
In some of the castles, when counted, the cubes do not seem to add up or coincide with their designated number. This is because there may be unseen cubes that have been removed from the base. This does not leave floating blocks as I have made sure the cubes are connected to other cubes by at least 1 face (edges were not connective).
It was answered that these are original shaped cubes as I only included answers that evolved around one cube that could be multiplied by 2 or 4.

- 22 Cubes:

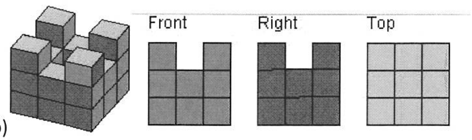


a)

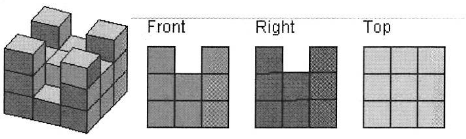
- 21 Cubes



a)



b)



c)

Annotations

Explains how many different three-dimensional objects with the required front, top and side views can be determined.

Determines many different three-dimensional objects that have the required front, top and side views by systematically considering configurations using different numbers of cubes.

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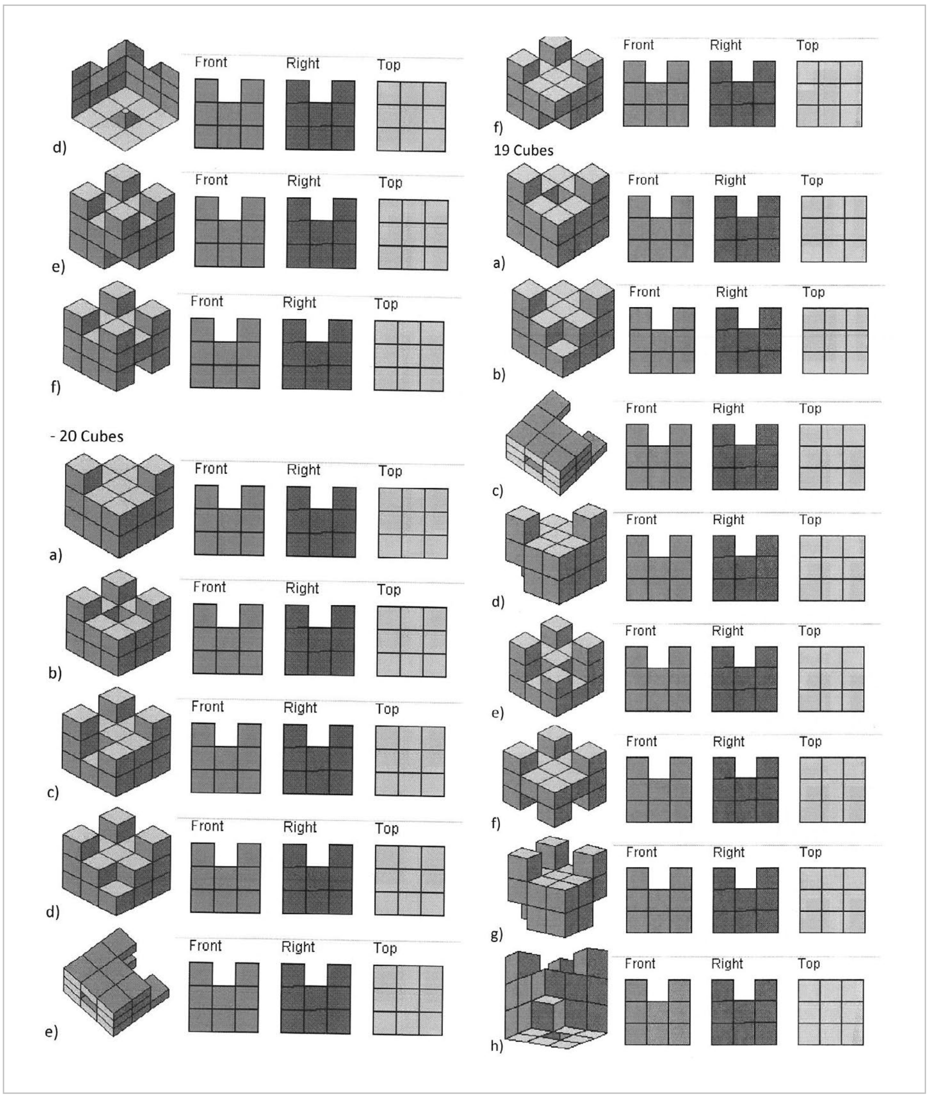
Geometry: Emily's castle



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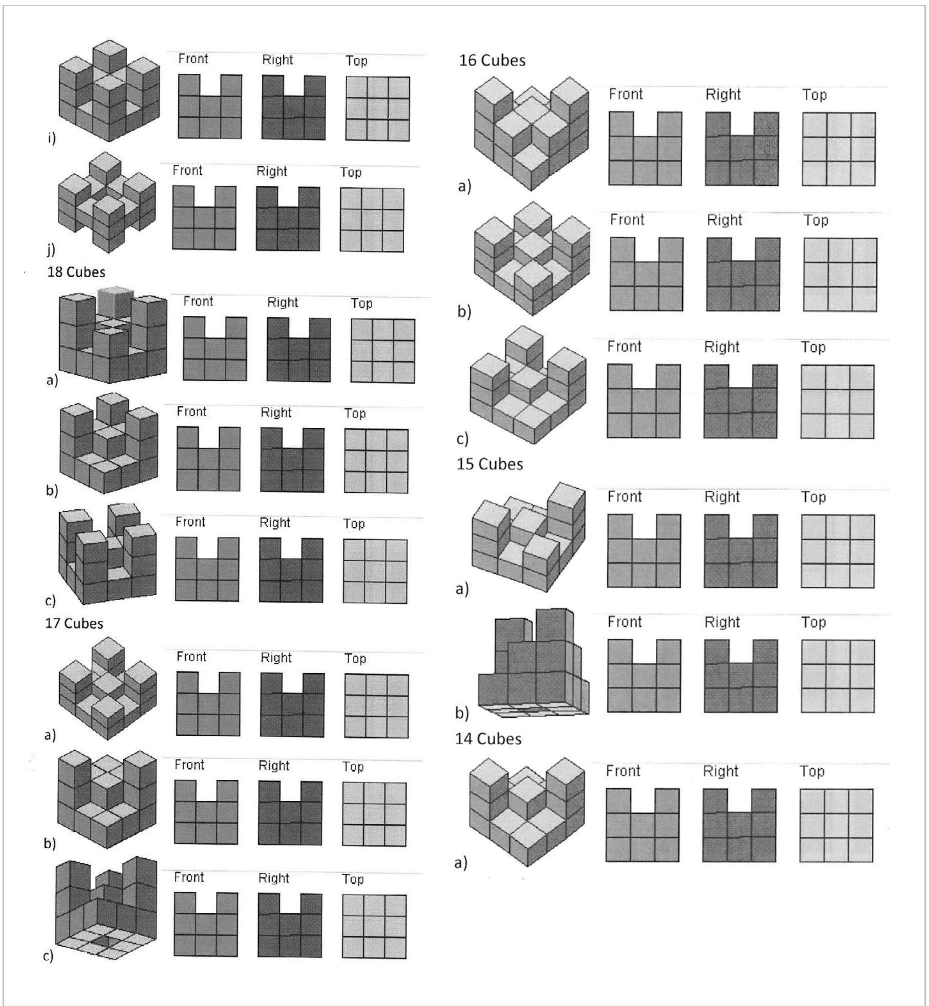
Geometry: Emily's castle



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Measurement: Measurement investigation

Year 7 Mathematics achievement standard

The parts of the achievement standard targeted in the assessment task are highlighted.

> *By the end of Year 7, students solve problems involving the comparison, addition and subtraction of integers. They make the connections between whole numbers and index notation and the relationship between perfect squares and square roots. They solve problems involving percentages and all four operations with fractions and decimals. They compare the cost of items to make financial decisions. Students represent numbers using variables. They connect the laws and properties for numbers to algebra. They interpret simple linear representations and model authentic information. Students describe different views of three-dimensional objects. They represent transformations in the Cartesian plane. They solve simple numerical problems involving angles formed by a transversal crossing two parallel lines. Students identify issues involving the collection of continuous data. They describe the relationship between the median and mean in data displays.*
>
> *Students use fractions, decimals and percentages, and their equivalences. They express one quantity as a fraction or percentage of another. Students solve simple linear equations and evaluate algebraic expressions after numerical substitution. They assign ordered pairs to given points on the Cartesian plane. Students use formulas for the area and perimeter of rectangles and calculate volumes of rectangular prisms. Students classify triangles and quadrilaterals. They name the types of angles formed by a transversal crossing parallel line. Students determine the sample space for simple experiments with equally likely outcomes and assign probabilities to those outcomes. They calculate mean, mode, median and range for data sets. They construct stem-and-leaf plots and dot-plots.*

Summary of task

Students were asked to complete the following task as a culminating activity on a unit of work.

1. Calculate the volume and surface area of this rectangular prism made from cubes with lengths of 1 cm.
2. This set of cubes is arranged to form a different rectangular prism.

   a. What do you know about the volume of the new prism?
   b. Use isometric dot paper to draw examples of what the new prism may look like.
   c. For at least two of your examples, calculate the area of each face of the prism and add these to find the total surface area.
   d. Explain how you would construct the rectangular prism using all of these cubes, so that it had the largest possible surface area.
   e. Collate your calculations in a table to demonstrate your answer.
   f. Provide a written explanation of your reasoning.
   g. Write a conclusion about what you discovered and how you discovered it.

Measurement: Measurement investigation

1. $4cm \times 2cm \times 3cm = 24cm^3$

$V = 24cm^3$

SA

(Front) $3cm \times 4cm = 12cm^2$
$12cm^2 \times 2 = 24cm^2$

(Top) $2cm \times 4cm = 8cm^2$
$8cm^2 \times 2 = 16cm^2$

(End) $2cm \times 3cm = 6cm^2$
$6cm^2 \times 2 = 12cm^2$

24
$+16$
$+12$
52

$SA = 52cm^2$

2A.
Prism 1

$2cm \times 6cm \times 2cm = 24cm^3$

$V = 24cm^3$

Prism 2

$2cm \times 12cm \times 1cm = 24cm^3$

$V = 24cm^3$

2C
Prism 1 SA

(Front) $2cm \times 2cm = 4cm^2$
$4cm^2 \times 2 = 8cm^2$

(Top) $2cm \times 6cm = 12cm^2$
$12cm^2 \times 2 = 24cm^2$

(End) $2cm \times 6cm = 12cm^2$
$12cm^2 \times 2 = 24cm^2$

8
$+24$
$+24$
56

$SA = 56cm^2$

Annotations

Calculates the volume of a prism using appropriate units.

Finds the area of each face of a rectangular prism in order to calculate its total surface area using appropriate units.

Verifies that the new prisms have the same volume as the given prism.

Determines the surface areas of two new prisms with the same volume as the given prism.

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Measurement: Measurement investigation

Prism 2 SA

(Front) 2cm X 1cm = 2cm²
2cm² X 2 = 4cm²

(Top) 2cm X 12cm = 24cm²
24cm² x 2 = 48cm²

(End) 1cm X 12cm = 12cm²
12cm² X 2 = 24cm²

4
+ 48
+ 24
76

SA = 76cm²

2D Largest possible surface area.

To find the largest surface area you would have to brake it down to one long colum 1cm by 1cm by 24cm because there is the most surface area exposed possible for each cube.

2E

Prisms	Dimensions	Volume	S.Area
Original	4x2x3	24cm³	52cm²
Prism 1	2x6x2	24cm³	56cm²
Prism 2	2x12x1	24cm³	76cm²
Largest SA	1x1x24	24cm³	96cm²

2F Conclusion

Each rectangular prisms volume was 24cm³ but every Surface Area was different and I found that the less colums and longer colums let more area exposed.

Annotations

Identifies the prism that can have the largest possible surface area.

Explains how the surface area of a prism can be increased.

Records the dimensions and surface areas of rectangular prisms.

Draws conclusions about surface area from investigation.

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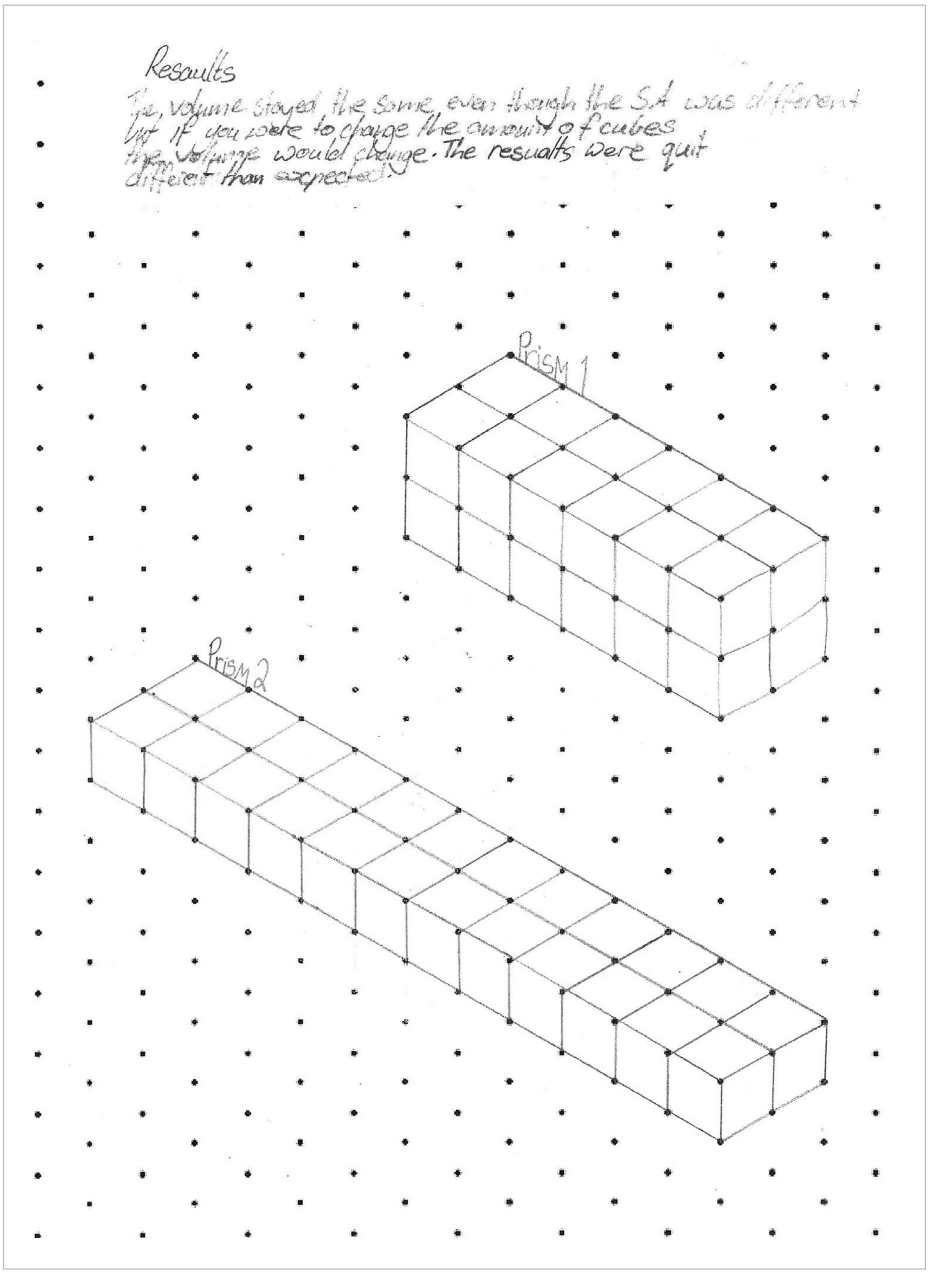
Measurement: Measurement investigation



Annotations

Demonstrates understanding of the conservation of volume.

Draws alternative prisms with the required volume of 24 cubic centimetres on isometric paper.

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